Better Maternal Outcomes
Public Webinar Series

Maternal Sepsis: Improving Care and Outcomes
WebEx Quick Reference

• Please use chat to "All Participants" for discussion & questions

• For technology issues only, please chat to "Host"
Microphone Feature

To mute your line, please press the microphone icon
Press it again to unmute.

Muted

Able to speak
Today’s Agenda

• Welcome & Introductions

• Maternal Sepsis: Best Practices for Prevention and Treatment

• Questions and Discussion

• Follow-Up & Staying Connected
Please type your **name** and the **organization** you represent in the chat box and send to “All Participants”

Example: Mara Lee, Midwest Health
Where are you joining from?
Partnering for Improved Birth Outcomes

The Institute for Healthcare Improvement (IHI) Better Maternal Outcomes Initiative and the National Network of Perinatal Quality Collaboratives (NNPQC), coordinated by NICHQ, are partnering to provide participants with a valuable set of webinars on health equity, respectful care and other critical maternal health topics. This partnership recognizes the shared commitment of these two initiatives to improve hospitals and health systems by elevating and spreading evidence-based efforts and examples of improvement from across the country so that families experience better birth outcomes. By bringing all participants together to engage in shared learning, the NNPQC and the Better Maternal Outcomes Initiative will encourage collaboration and innovation among teams with a shared mission, and ultimately accelerate national improvement.
The IHI Better Maternal Outcomes Initiative aims to reduce maternal morbidity and mortality by supporting national efforts to implement reliable evidence-based care for women and newborns around the time of birth, and by facilitating locally driven, co-designed rapid improvements in four communities, targeting the interface of health care delivery, the experience of birthers, and community support systems.

The National Network of Perinatal Quality Collaboratives (NNPQC), coordinated by NICHQ, supports the development and enhances the ability of state perinatal quality collaboratives to make measurable improvements in statewide maternal and infant healthcare and health outcomes by providing resources and expertise to nationwide state-based perinatal quality collaboratives (PQCs). The National Institute for Children’s Health Quality (NICHQ) serves as the National Coordinating Center for NNPQC.
Today’s Speakers

**Melissa E. Bauer, DO**  
Clinical Associate Professor of Anesthesiology  
Duke University Medical Center

**Margie Bridges, DNP, ARNP-BC, RNC-OB**  
Perinatal Clinical Nurse Specialist  
Childbirth Center  
Overlake Medical Center, Bellevue, WA

**Keelee Moseley**  
Maternal Sepsis Survivor
The journey

Life will lead you to unimaginable journeys...

01 The Reveal
02 New Beginnings
03 Diagnosis
04 Life NOW
The Reveal
Christmas Day 2017
I was a mid career level as Senior Software Engineer and married with two children, ages 13 and 18.
**PPROM**

*Preterm Premature Rupture of Membranes* is the breakage of the amniotic sac before the onset of labor. Women usually experience a painless gush or a steady leakage of fluid from the vagina. Preterm premature rupture of membranes is the rupture of membranes during pregnancy before 37 weeks’ gestation.

**IC**

An *incompetent cervix*, also called a *cervical* insufficiency, occurs when weak *cervical* tissue causes or contributes to premature birth or the loss of an otherwise healthy pregnancy.
New Beginnings

A micro-preemie
Babies born weighing under 1 pound 12 ounces or before 26 weeks of gestation
Post Delivery
Returned to ER in less than 24 hours from discharge

Initial Symptoms
Extreme pain, fever, and chills.
Sepsis is about TIME

When it comes to sepsis, remember IT’S ABOUT TIME™. Watch for:

**T**
- TEMPERATURE: higher or lower than normal

**I**
- INFECTION: may have signs and symptoms of an infection

**M**
- MENTAL DECLINE: confused, sleepy, difficult to rouse

**E**
- EXTREMELY ILL: severe pain, discomfort, shortness of breath

If you experience a combination of these symptoms: seek urgent medical care, call 911, or go to the hospital with an advocate. Ask: “Could it be sepsis?”

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Things continued to get worse. My stomach grew bigger, hotter and I vomited.
Necrotizing Fasciitis (NF)

Necrotizing fasciitis (NECK-re-tie-zing FASH-e-i-tis) is a rare bacterial infection that spreads quickly in the body and can cause death.

Common signs of NF

- Fever
- A red, warm, or swollen area of skin that spreads quickly
- Severe pain, including pain beyond the area of the skin that is red, warm, or swollen
- Ulcers, blisters, or black spots on the skin
Certain storms are unavoidable; to survive a storm is a miracle.
I woke up in the ICU. I couldn't talk, and I learned that I had undergone a surgical debridement of Necrotizing Fasciitis. My kidneys were failing, which meant I would need additional blood transfusions. I was nearing DEATH, but the word sepsis was never mentioned.
To fully recover, I had to have multiple surgeries, a wound vacuum, and I needed a lot of assistance to become mobile again. I spent 34 days in the hospital for myself and 144 days with Adrian.

I got better.

Overcoming
The art of living is to know when to hold fast and when to let go.
"Patience and perseverance have a magical effect before which difficulties disappear and obstacles vanish." – John Quincy Adams
Defining Moments

63%

Over time, I learned so much about my diagnosis. I had stage two of sepsis, and research shows that 63% of people died from stage two sepsis.
Today, when I look back at my journey, it was not easy, but everything I experienced was worth it. This has been a life defining event like no other; however, by the grace of God, my family overcame a very difficult time, and we are doing better than ever.
“This journey was given to me as a special assignment so that I can use my voice to make an impact for those before me and yet to come. We must never take for granted the gift of hearing.” - Keelee

“Life’s most persistent and urgent question is, ‘What are you doing for others?’” - Martin Luther King, Jr.
Merck’s $500 million initiative to help create a world where no woman has to while die giving life.

Our approach harnesses the invention and expertise of the private sector to solve a local and global health challenge.

merckformothers.com
THANK YOU!

Contact me:

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IG: @keeleenichole
Twitter: @keeleemoseley
Email: keeleemoseley@gmail.com
Maternal Sepsis: Common Pitfalls and How to Avoid Them

Melissa E. Bauer, D.O.
Associate Professor of Anesthesiology
Department of Anesthesiology
Duke University
Disclosures

• Advisory Board Sepsis Alliance
• Editor for California Maternal Quality Care Collaborative Maternal Sepsis Toolkit
Overview

• Definition
• Incidence
• Why do mothers die from sepsis?
  – Delay in recognition
  – Delay in escalation of care
  – Delay in appropriate antibiotics

Towards a consensus definition of maternal sepsis: results of a systematic review and expert consultation

- Life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period
Incidence and Mortality

- Varies due to case ascertainment and definitions
- Sepsis incidence
  - Sepsis (1:2500, 1:4200, 1:10,000)
- Mortality
  - 9%, 10%, 14%
# Preventability

<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>North Carolina</th>
<th>Michigan</th>
</tr>
</thead>
<tbody>
<tr>
<td>47% Care Classification - Improvements to care which may have made a difference to outcome</td>
<td>43% Preventable</td>
<td>73% Delay in appropriate antibiotics 53% Delay in escalation of care</td>
</tr>
</tbody>
</table>

Maternal Deaths Due to Sepsis in the State of Michigan, 1999–2006

Melissa E. Bauer, DO, Robert P. Lorenz, MD, Samuel T. Bauer, MD, Krishna Rao, MD, MS, and Frank W.J. Anderson, MD, MPH

- Why do mothers die from sepsis?
  - Delays in recognition
  - Delays in escalation of care
  - Delays in appropriate antibiotics
Recognition

Risk Factors

Screening tools
Severe Maternal Sepsis in the UK, 2011–2012: A National Case-Control Study

Colleen D. Acosta1, Jennifer J. Kurinczuk1, D. Nuala Lucas2, Derek J. Tuffnell3, Susan Sellers4, Marian Knight5 on behalf of the United Kingdom Obstetric Surveillance System
1 National Perinatal Epidemiology Unit, University of Oxford, Oxford, United Kingdom; 2 Department of Anaesthetics, Northwick Park Hospital, Harrow, United Kingdom; 3 Bradford Royal Infirmary, Bradford Hospitals NHS Trust, Bradford, United Kingdom; 4 St Michael’s Hospital, University Hospitals Birmingham NHS Trust, Birmingham, United Kingdom

Abstract

Background: In light of increasing rates and severity of sepsis worldwide, this study aimed to estimate the incidence of, and describe the causative organisms, sources of infection, and risk factors for, severe maternal sepsis in the UK.

Methods and Findings: A prospective case-control study included 365 confirmed cases of severe maternal sepsis and 757 controls from all UK obstetrician-led maternity units from June 1, 2011, to May 31, 2012. Incidence of severe sepsis was 4.7 (95% CI: 4.2–5.2) per 10,000 maternities; 71 (19.3%) women developed septic shock, and five (1.4%) women died. Genitourinary tract infection (31.0%) and the organism Escherichia coli (21.1%) were most common. Women had significantly increased adjusted odds ratios (aORs) of severe sepsis if they were black or other ethnic minority (aOR = 1.82; 95% CI: 1.82–2.51), were preterm (aOR = 1.68; 95% CI: 1.17–2.36), had a pre-existing medical problem (aOR = 1.46; 95% CI: 1.01–1.98), had febrile illness or were taking antibiotics in the 2 wk prior to presentation (aOR = 12.07; 95% CI: 8.11–17.97), or had an operative vaginal delivery (aOR = 2.46; 95% CI: 1.32–4.70), pre-labour caesarean (aOR = 3.83; 95% CI: 2.24–6.56), or caesarean after labour onset (aOR = 8.06; 95% CI: 4.65–13.97). Median time between delivery and sepsis was 3 d (interquartile range = 1–7 d). Multiple pregnancy (aOR = 2.75; 95% CI: 1.34–21.45) and infection with group A streptococci (aOR = 4.84; 2.17–10.78) were associated with progression to septic shock for 16 (50%) women with a group A streptococcal infection there was <2 h—and for 24 (75%) women, <9 h—between the first sign of systemic inflammatory response syndrome and a diagnosis of severe sepsis. A limitation of this study was the proportion of women with sepsis without an identified organism or infection source (14%).

Conclusions: For each maternal sepsis death, approximately 50 women have life-threatening morbidity from sepsis. Follow-up to ensure infection is eradicated is important. The rapid progression to severe sepsis highlights the importance of following the international surviving sepsis campaign guideline of early administration of high-dose intravenous antibiotics within 1 h of admission to hospital for anyone with suspected sepsis. Signs of severe sepsis in peripartum women, particularly with confirmed or suspected group A streptococcal infection, should be regarded as an obstetric emergency.

Please see later in the article for the Editors’ Summary.


Academic Editor: Nicholas M. Frisk, University of Queensland, Australia

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Data Availability: The authors confirm that all data underlying the findings are fully available without restriction. All data underlying the findings are available by request to the National Perinatal Epidemiology Unit Data Sharing Committee.

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Competing Interests: LS is Chief of the Claims Advisory Committee at the Medical Protection Society for which she receives an honorarium. All other authors have declared that no competing interests exist.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio; SIRS, systemic inflammatory response syndrome; UKSSS, United Kingdom Obstetric Surveillance System; uOR, unadjusted odds ratio.

* Email: marian.knight@npeu.ox.ac.uk

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Risk factors

• Common associations across all studies:
  – Cesarean delivery
  – Medicaid insurance
  – Multiple gestation
  – Underrepresented minority groups
  – Postpartum hemorrhage
  – Preterm delivery
• Sepsis often occurred in women without risk factors

• Develop surveillance systems to help increase disease detection
Screening tools
Quick Sepsis-related Organ Failure Assessment (qSOFA)
The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

Box 4. qSOFA (Quick SOFA) Criteria

- Respiratory rate $\geq 22$/min
- Altered mentation
- Systolic blood pressure $\leq 100$ mm Hg
Internal Validation of the Sepsis in Obstetrics Score to Identify Risk of Morbidity From Sepsis in Pregnancy

Catherine M. Albright, MD, Phinnara Has, MS, Dwight J. Rouse, MD, and Brenna L. Hughes, MD

- **qSOFA**
  - Sensitivity 35.7%
  - Specificity 89.3%

- Zero patients had mental status changes
Risk Factors, Etiologies, and Screening Tools for Sepsis in Pregnant Women: A Multicenter Case-Control Study

• qSOFA
  Sensitivity 50%
  Specificity 95%

• Very few manifested mental status changes
  17 (37.8%)
Risk Factors, Etiologies, and Screening Tools for Sepsis in Pregnant Women: A Multicenter Case-Control Study

- **SIRS**
  - Sensitivity 93%
  - Specificity 63%

- **MEWC**
  - Sensitivity 82%
  - Specificity 87%
Maternal Early Warning Criteria (MEWC)
## The Maternal Early Warning Criteria

**A Proposal From the National Partnership for Maternal Safety**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>&lt;90 or &gt;160</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Heart rate (beats per min)</td>
<td>&lt;50 or &gt;120</td>
</tr>
<tr>
<td>Respiratory rate (breaths per min)</td>
<td>&lt;10 or &gt;30</td>
</tr>
<tr>
<td>Oxygen saturation on room air, at sea level, %</td>
<td>&lt;95</td>
</tr>
<tr>
<td>Oliguria, mL/hr for ≥2 hours</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Maternal agitation, confusion, or unresponsiveness; Patient</td>
<td></td>
</tr>
<tr>
<td>with preeclampsia reporting a non-remitting headache or shortness of breath</td>
<td></td>
</tr>
</tbody>
</table>
National Partnership for Maternal Safety
Recommended Maternal Early Warning Criteria Are Associated With Maternal Morbidity

<table>
<thead>
<tr>
<th>Trigger Criteria</th>
<th>Total (n = 400)</th>
<th>With Morbidity (n = 99)</th>
<th>Without Morbidity (n = 301)</th>
<th>Relative Risk (99.5% CI) of Morbidity Given Vital Sign Trigger</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP &gt;160</td>
<td>52 (13%)</td>
<td>29 (29%)</td>
<td>23 (8%)</td>
<td>2.77 (1.75–4.38)</td>
<td>&lt;.0001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>SBP &lt;90</td>
<td>66 (17%)</td>
<td>21 (21%)</td>
<td>45 (15%)</td>
<td>1.36 (0.77–2.42)</td>
<td>.15</td>
</tr>
<tr>
<td>DBP &gt;100</td>
<td>39 (10%)</td>
<td>19 (19%)</td>
<td>20 (7%)</td>
<td>2.2 (1.28–3.76)</td>
<td>.0003&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>HR &gt;120</td>
<td>105 (26%)</td>
<td>50 (51%)</td>
<td>55 (18%)</td>
<td>2.87 (1.80–4.57)</td>
<td>&lt;.0001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>HR &lt;50</td>
<td>7 (2%)</td>
<td>3 (3%)</td>
<td>4 (1%)</td>
<td>1.75 (0.50–6.12)</td>
<td>.37</td>
</tr>
<tr>
<td>RR &gt;30</td>
<td>9 (2%)</td>
<td>8 (8%)</td>
<td>1 (0.3%)</td>
<td>3.82 (2.51–5.81)</td>
<td>&lt;.0001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>RR &lt;10</td>
<td>4 (1%)</td>
<td>2 (2%)</td>
<td>2 (1%)</td>
<td>2.04 (0.49–8.49)</td>
<td>.26</td>
</tr>
<tr>
<td>Svo&lt;sub&gt;2&lt;/sub&gt; &lt;95%</td>
<td>183 (46%)</td>
<td>61 (62%)</td>
<td>122 (38%)</td>
<td>1.9 (1.14–3.16)</td>
<td>.0003&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>T &gt;38.5</td>
<td>11 (3%)</td>
<td>10 (10%)</td>
<td>1 (0.3%)</td>
<td>3.97 (2.73–5.78)</td>
<td>&lt;.0001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Oliguria</td>
<td>14 (4%)</td>
<td>7 (7%)</td>
<td>7 (2%)</td>
<td>2.1 (0.95–4.63)</td>
<td>.03</td>
</tr>
</tbody>
</table>
### Maternal Deaths Due to Sepsis in the State of Michigan, 1999–2006

| Remainder of vital signs not available from transferring hospital, SpO2: 67% on RA | HR: 142  
| RR: 24  
| BP: 145/72  
| T: 36.1°C  
| SpO2 not done | HR: 80  
| RR: 40  
| BP: 108/60  
| T: 37.1°C  
| SpO2 not done |
| HR: 110  
| RR: 24  
| BP: 86/64  
| T: 38.3°C  
| SpO2: 93% on RA | HR: 135  
| RR: 24  
| BP: 70/45  
| T: 36.5°C  
| SpO2: 98% on RA | HR: 87  
| RR: 20  
| BP: 128/77  
| T: 36.2°C  
| SpO2: 96% on RA |
| HR: 115  
| RR: 20  
| BP: 113/70  
| T: 34.8°C  
| SpO2 not done | HR: 142  
| RR: 40  
| BP: 117/70  
| T: 36.9°C  
| SpO2: 83% on RA | HR: 161  
| RR: 20  
| BP: 110/77  
| T: 39.7°C  
| SpO2: 95% on 2LNC |
| HR: 90  
| RR: 18  
| BP: 126/89  
| T: 36.4°C  
| SpO2: 100% on RA | HR: 142  
| RR: 60  
| BP: 146/50  
| T: 37.1°C  
| SpO2: 99% on RA | HR: 119  
| RR: 24  
| BP: 126/92  
| T: 36.3°C  
| SpO2: 70% on RA |
| Remainder of vital signs not available from transferring hospital, SpO2: 67% on RA | HR: 142  
RR: 24  
BP: 145/72  
T: 36.1°C  
SpO2 not done | HR: 80  
RR: 40  
BP: 108/60  
T: 37.1°C  
SpO2 not done |
|---|---|---|
| HR: 110  
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SpO2: 98% on RA | HR: 87  
RR: 20  
BP: 128/77  
T: 36.2°C  
SpO2: 96% on RA |
| HR: 115  
RR: 20  
BP: 113/70  
T: 34.8°C  
SpO2 not done | HR: 142  
RR: 40  
BP: 117/70  
T: 36.9°C  
**SpO2: 83% on RA** | HR: 161  
RR: 20  
BP: 110/77  
T: 39.7°C  
**SpO2: 95% on 2LNC** |
| HR: 90  
RR: 18  
BP: 126/89  
T: 36.4°C  
**SpO2: 100% on RA** | HR: 142  
RR: 60  
BP: 146/50  
T: 37.1°C  
SpO2: 99% on RA | HR: 119  
RR: 24  
BP: 126/92  
T: 36.3°C  
**SpO2: 70% on RA** |

Two standard deviations from the mean:

- 38.1°C (100.6°F)
- Heart rate = 107 beats per minute
- Respiratory rate = > 24 breaths per minute
- Assuming a normal distribution, patients meeting these thresholds for each criterion would occur 2.5% of the time. It would be expected that approximately 2.5% or less (since two or more criteria are required) of patients may meet the proposed screening criteria due to physiological changes of pregnancy rather than infection.

CMQCC Diagnosis of Maternal Sepsis: A Two-Step Approach

- Aims to reduce false positives (avoid ‘alarm fatigue’) and reduce false negatives (avoid missing cases)
- Is based on clinical practice data sets from three hospital systems in CA with adjustment for physiologic changes of pregnancy
- Features a two-step approach: a screening step followed by a confirmatory step
Performance of Two-Step System for Diagnosis of Maternal Sepsis (data extracted from clinical practice data sets, not formal research studies)

<table>
<thead>
<tr>
<th>Source</th>
<th>OB Vital Signs Screen</th>
<th>Sepsis (End Organ Injury)</th>
<th>Among Screen Positive (Sens)</th>
<th>Not Among Screen Positive (Spec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Systems*</td>
<td>14,752</td>
<td>199 (1.3%)</td>
<td>33 (16.6% of screen positives) (0.22% of all screened)</td>
<td>32 (97%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (3%)</td>
</tr>
</tbody>
</table>

Notes: (1) Initial screen positive rate is 1.3%

(2) Overall performance of the Two-Step System as shown above gives an approximate sensitivity of 97% and an approximate specificity of 99%

* Data from Dignity Health and Sutter Health

Courtesy of CMQCC
NOTE: A MAP < 65 mm Hg (persistent after 30m/kg fluid load) in setting of infection directly defines SEPTIC SHOCK.

Step 1: Initial Sepsis Screen
- Oral temp < 36°C (96.8°F) or > 38°C (100.4°F)
- Heart rate > 110 beats per minute
- Respiratory rate > 24 breaths per minute
- WBCs > 15,000/mm³ or < 4,000/mm³ or > 10% bands
Positive if any 2 of 4 criteria met

Action: If suspected infection, start source-directed antibiotics and 1-2 L of IV fluids; increase monitoring and surveillance. Move to confirmation evaluation.

Step 2: Confirmation of Sepsis Evaluation
- Respiratory: New need for mechanical ventilation or PaO2/FiO2 < 300
- Coagulation: Platelets < 100 x 10⁹/L or INR > 1.5 or PTT > 60 secs
- Liver: Bilirubin > 2 mg/dL
- Cardiovascular: SBP < 85 mm Hg or MAP < 65 mm Hg or > 40 mm Hg decrease in SBP (after fluids)
- Renal: Creatinine ≥ 1.2 mg/dL or doubling of creatinine or urine output < 0.5 ml/kg/hr x 2 hrs
- Mental Status: Agitated, confused, or unresponsive
- Lactic Acid: > 2 mmol/L in absence of labor
Confirmed if 1 or more criteria met

≥ 3 Criterion POSITIVE defines SEPSIS

MAP < 65 mm Hg (with confirmation) defines SEPTIC SHOCK

Action: Start source-directed antibiotics, broad spectrum antibiotics if source unclear; increase fluids to 30 m/kg within 3 hours; collect blood cultures if not already obtained, maintain close surveillance, e.g. RRT, and repeat lactate. Escalate care as needed.

Action: At a minimum, maintain close surveillance; consider additional fluids to reduce lactate acid level; repeat lactate. (See Discussion of the Role of Lactic Acid in the Peripartum Period in the toolkit for more detail.)

All Criteria NEGATIVE

Elevated lactate ONLY in labor

Action: This group remains at high risk for sepsis and requires close supervision and reevaluation.

Sepsis Evaluation Flow Chart

Courtesy of CMQCC
Initial Sepsis Screen (Step 1)

Step 1: Initial Sepsis Screen
- Oral temp < 36°C (96.8°F) or > 38°C (100.4°F)
- Heart rate > 110 beats per minute
- Respiratory rate > 24 breaths per min
- WBCs > 15,000/mm³ or < 4,000/mm³ or > 10% bands
  Positive if any 2 of 4 criteria met

Action: If suspected infection, start source-directed antibiotics and 1-2 L of IV fluids; increase monitoring and surveillance.
Move to confirmation evaluation.

NOTE:
A MAP < 65 mm Hg (persistent after 30ml/kg fluid load) in setting of infection directly defines SEPTIC SHOCK

Courtesy of CMQCC
## Step 2: Criteria for end organ injury

<table>
<thead>
<tr>
<th>Measure of End Organ Injury</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| **Respiratory function***    | Acute respiratory failure as evidenced by acute need for invasive or non-invasive mechanical ventilation, OR  
|                             | PaO₂/FiO₂ < 300 |
| **Coagulation status**      | Platelets < 100 x 10⁹/L, OR  
|                             | International Normalized Ratio (INR) > 1.5, OR  
|                             | Partial Thromboplastin Time (PTT) > 60 seconds |
| **Liver function**           | Bilirubin > 2 mg/dL |
| **Cardiovascular function**  | Persistent hypotension after fluid administration:  
|                             | o SBP < 85 mm Hg, OR  
|                             | o MAP < 65 mm Hg, OR  
|                             | o > 40 mm Hg decrease in SBP |
| **Renal function**           | Creatinine > 1.2mg/dL, OR  
|                             | Doubling of serum creatinine, OR  
|                             | Urine output less 0.5 mL/kg/hour (for 2 hours) |
| **Mental status assessment** | Agitation, confusion, or unresponsiveness |
| **Lactic acid**              | > 2 mmol/L in absence of labor  
|                             | (Lactic acid not used for diagnosis in labor, but remains important for treatment.) |

*Courtesy of CMQCC*
Confirmation of Sepsis Evaluation: Step 2

Step 2: Confirmation of Sepsis Evaluation

- Respiratory: New need for mechanical ventilation or PaO2/FiO2 < 300
- Coagulation: Platelets < 100 x 10^9/L or INR > 1.5 or PTT > 60 secs
- Liver: Bilirubin > 2 mg/dL
- Cardiovascular: SBP < 85 mm Hg or MAP < 65 mm Hg or > 40 mm Hg decrease in SBP (after fluids)
- Renal: Creatinine ≥ 1.2 mg/dL or doubling of creatinine or urine output < 0.5 ml/kg/hr x 2 hrs
- Mental Status: Agitated, confused, or unresponsive
- Lactic Acid: > 2 mmol/L in absence of labor

Confirmed if 1 or more criteria met

**Action:**
- This group remains at high risk for sepsis and requires close supervision and reevaluation.
- Elevated lactate ONLY in Labor
- MAP < 65 mm Hg (with confirmation) defines SEPTIC SHOCK

**Action:**
- Start source-directed antibiotics, broad spectrum antibiotics if source unclear; increase fluids to 30 ml/kg within 3 hours; collect blood cultures if not already obtained, maintain close surveillance, e.g. RRT, and repeat lactate. Escalate care as needed.

**Action:**
- As above for Sepsis, admit to ICU. If hypotension persists after 30 ml/kg fluid load, assess hemodynamic status and consider vasopressor use.

Courtesy of CMQCC
Treatment

Antibiotics

Fluid administration
Antibiotics

We recommend that administration of IV antimicrobials should be initiated as soon as possible after recognition and within one hour for both sepsis and septic shock (strong recommendation, moderate quality of evidence).
• Only 13% (2/15) patients received appropriate initial antibiotics
• After ICU or ID consult, 67% (10/15) were appropriate for clinical situation
  – 20% (3/15) did not live long enough for subsequent therapy
  – 13% (2/15) appropriateness was unable to be determined
Antibiotics within one hour
- 8% mortality

Antibiotics after one hour
- 20% mortality
### TABLE 9. Proposed Empiric Antibiotic Coverage for Patients with Sepsis of Unknown Source (with End Organ Injury) or Septic Shock

<table>
<thead>
<tr>
<th>Antibiotic Choices</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empiric coverage for sepsis of unknown source or for septic shock should include at least one antibiotic for Gram-negative and anaerobic coverage PLUS one for Gram-positive coverage</td>
<td>7-10 days is adequate for most infections</td>
</tr>
</tbody>
</table>

**Gram-negative plus anaerobic coverage**
- Piperacillin/tazobactam 3.375 g IV q8h (extended infusion) or 4.5 g IV q6h
- OR
- Meropenem 1 g IV q8h (if recent hospitalization or concern for MDRO organisms)
- OR
- Cefepime 1-2g IV q8h plus metronidazole 500 mg IV q8h
- OR
- Aztreonam 2 g IV q8h (for women with severe penicillin allergy)
  - Plus metronidazole 500 mg IV q8h
- OR
- Aztreonam 2g IV q8h plus clindamycin 900 mg IV q8h

**Gram-positive coverage**
- Vancomycin 15-20 mg/kg q8h-q12h (goal trough 15-20 mcg/mL)
- OR
- Linezolid 600 mg IV/PO q12h (for women with severe vancomycin allergy)
Combination therapy

• Clindamycin with β-lactams to inhibit exotoxin production
  – Group A streptococcus

We suggest empiric combination therapy (using at least two antibiotics of different antimicrobial classes) aimed at the most likely bacterial pathogen(s) for the initial management of septic shock (weak recommendation, low quality of evidence).

Fluid administration

A. INITIAL RESUSCITATION

We recommend that, in the resuscitation from sepsis-induced hypoperfusion, at least 30 mL/kg of IV crystalloid fluid be given within the first 3 hours (strong recommendation, low quality of evidence).

We suggest guiding resuscitation to normalize lactate in patients with elevated lactate levels as a marker of tissue hypoperfusion (weak recommendation, low quality of evidence).
Normal Range for Maternal Lactic Acid during Pregnancy and Labor: A Systematic Review and Meta-Analysis of Observational Studies

• 22 studies
• 1,193 patients
• 2,008 observations
During Pregnancy

2\textsuperscript{nd} stage of Labor
At Delivery

Escalation of Care
The Sepsis in Obstetrics Score: a model to identify risk of morbidity from sepsis in pregnancy

<table>
<thead>
<tr>
<th>Variable</th>
<th>High abnormal range</th>
<th>Normal</th>
<th>Low abnormal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>-4</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>&gt;40.9</td>
<td>36-38.4</td>
<td>34-35.9</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mmHg)</td>
<td>&gt;90</td>
<td>70-90</td>
<td>&lt;70</td>
</tr>
<tr>
<td>Heart Rate (beats per minute)</td>
<td>&gt;179</td>
<td>120-129</td>
<td>≤119</td>
</tr>
<tr>
<td>Respiratory Rate (breaths per minute)</td>
<td>&gt;49</td>
<td>25-34</td>
<td>12-24</td>
</tr>
<tr>
<td>SpO₂ (%)</td>
<td>≥92%</td>
<td>85-89%</td>
<td>≤85%</td>
</tr>
<tr>
<td>White Blood Cell Count (μL)</td>
<td>&gt;39.9</td>
<td>25-39.9</td>
<td>17-24.9</td>
</tr>
<tr>
<td>% Immature Neutrophils</td>
<td>≥10%</td>
<td>&lt;10%</td>
<td>1-2.9</td>
</tr>
<tr>
<td>Lactic Acid (mmol/L)</td>
<td>≥4</td>
<td>&lt;4</td>
<td></td>
</tr>
</tbody>
</table>

Scoring template for S.O.S., a sepsis scoring system designed specifically for obstetric patients.

S.O.S., Sepsis in Obstetrics Score; SpO₂, blood oxygen saturation.

Albright et al. AJOG (2014)
## Sepsis Obstetrics Scoring System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (Centigrade) (°C)</td>
<td></td>
</tr>
<tr>
<td>35 - 37.4°C (95.8 - 101.1°F)</td>
<td></td>
</tr>
<tr>
<td>SpO2% blood oxygen saturation</td>
<td>≥ 90%</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>&gt; 90</td>
</tr>
<tr>
<td>White blood count uL</td>
<td>5.7 - 16.9</td>
</tr>
<tr>
<td>Heart Rate (beats per minute)</td>
<td>≤ 119</td>
</tr>
<tr>
<td>% Immature Neutrophils</td>
<td>&lt; 10%</td>
</tr>
<tr>
<td>Respiratory Rate (breaths per minute)</td>
<td>12 - 24</td>
</tr>
<tr>
<td>Lactic Acid (mmol/L)</td>
<td>&lt; 4</td>
</tr>
</tbody>
</table>

**Calculate Sepsis Obstetrics Score (S.O.S)**

[http://perinatology.com/calculators/Sepsis%20Calculator.htm](http://perinatology.com/calculators/Sepsis%20Calculator.htm)
Summary

• Sepsis is rare, but preventable cause of maternal mortality
Action Items

• Recognition
  • Develop sepsis screening

• Treatment
  • Work with pharmacy to obtain prompt antibiotics
  • Antibiotic selection

• Escalation of care
  • Have criteria for escalation of care
Thank you

• Sepsis Alliance
• Institute for Healthcare Improvement
• Maternal sepsis researchers
• Contact information: Melissa.e.bauer@duke.edu
• Twitter: @MelissaEBauer1
A Case For Change:

349-bed, nonprofit regional medical center
Level III Trauma Center
Approximately 22,000 admissions/year
Over 45,000 ED visits
4,000 Births/year

OB sepsis Case studies

Margie Bridges, DNP, ARNP-BC, RNC-OB
Perinatal Clinical Nurse Specialist
Women and Infant's Services
Case Studies & a Case for Change

How many of you have adopted OB Sepsis protocol into your organization?
CASE Presentation:
Before OB SEPSIS PROTOCOL
16 year old Primagravida- Vacuum delivery 1st degree laceration

Postpartum Day 1:
Reported feeling “very tired”, pain well controlled with current meds, ambulating well, tolerating reg diet. Baby doing well, BF well

WBC 16.4  T 36.2  BP 118/71 Pulse 115 RR: 18

3 Hours Later:
Pain 9/10 not well controlled with current medications: Crying from exhaustion and pain, limited coping mechanisms. C/O Cramping stiches, hemorrhoids. Developed chest pain, right shoulder pain, SOB, N/V, dizziness

T: 38.7  HR: 120-156  BP: 95/45-76/34 RR: 40-47
WBC=*1.7 repeat 1.6

Mother comments that this is not her typical response to pain or stress
OB Case Continued:

**Rapid Response Team:** CT Scan, Pulmonary angiogram, Abdominal Ultrasound

**Transferred to Critical Care Unit:**

- BP: 68/40 P:155-160 Sa02 87% on 6L  Lactate 4.8
- Sepsis protocol initiated
- IV antibiotics (Unasyn, Clindamycin, Vancomycin)
- Fluid Volume Resuscitation
- Vasopressor Support
- Respiratory failure, increasing pulmonary edema/pleural effusions. Intubated for respiratory support
- Decreased Urine output

**Major Goals** of sepsis management were met: *She was treated emergently with fluid resuscitation, antibiotic administration*....

What else?
OB Case Continued:

Postpartum Day 3:

**To OR for Surgery:** TAH, APPY, and Abdominal washout. Uterus was “mushy” and tissue friable

- 4 liters of purulent Ascites
- *Positive for GAS*
- Remained ventilated 9 days (ARDS)

Postpartum Day 18: Discharged Home

T: 36.5, BP: 127/75  P: 88 RR: 16  SaO2 100%
Maternal SEPSIS Standard work

Created Protocols with Adjusted SIRS criteria for Maternal Sepsis

- Heart Rate and Cardiac Output are ↑ due to ↑ blood volume
- Respiratory Rate ↑ are due to ↑ demand for oxygen and expanding abdominal girth
- WBC is normally ↑ in labor and immediate postpartum period unrelated to infection
G1P0, 37 weeks gestation, with uneventful pregnancy

0600: Admitted to L&D Initial Lab work VS WNL

1200: T (38°C) Tylenol was administered

Several Hours Later: Temp 41.1 °C, HR 115-120’s, Fetal Heart Rate 160-170’s
  - C/O of increased pain, despite epidural
  - Shaking
  - Change in her mental status (extreme restlessness, inability to stay still, and frantic unintelligible speech)

RRT was called & the Sepsis Bundle was initiated
  - C-Section
  - Baby was admitted to NICU
  - Mother’s blood cultures were positive for E. coli
  - Mom and baby were discharged in stable condition with antibiotic to continue at home
**Hospital-wide Sepsis education**
Spring 2014

**Sepsis Committee formed**
**Best practice review**
Sep 2014

**ED workflow planned for early Identification & Treatment**
**Pharmacy & Director of IP develop Antibiotic list. ED Sepsis Quicklist amended**

**PHASE 2**
**BPA built & tested behind scenes; iStat training done**
Jan 2015

**Sepsis Checklist Mar ’15**
**ED BPA in Production**
Mar – May ’15

**Sepsis Order Set Inpatient Build, Provider Education**
Dec 2015

**Mews for Inpatient**
Oct 2016

**RRT Protocols ED Fluid Documentation**
Aug 2017
**Dec 2017**

**MEWT in OB MEWT in EMR**
March 2018
**June 2018**

**Sepsis Checklist in EMR ALL RN Protocol**
TBD

**RN Sepsis Champion Sepsis Checklist OB Checklist**
Mar 2016

**SEPSIS**
Sepsis Alliance Resources
Pregnancy & Childbirth

Although pregnancy is the same for women worldwide, their safety varies greatly depending on where the women live and the type of medical care they receive, if any.

Sepsis is an illness that can develop in some pregnant women, as well as in women who have recently given birth (postpartum sepsis), or in women who have a bloodstream infection (endocarditis). Sepsis is caused by the body's response to an infection, and it can be life-threatening. It is a leading cause of pregnancy-related deaths in the United States.

What to look for if you are pregnant or recently gave birth:

- Fever above 100.4°F
- Difficulty breathing or shortness of breath
- Foul-smelling discharge from the vagina or a wound
- Chills
- Feeling confused or just "not right"
- General abdominal pain that appears, or gets much worse suddenly

If you experience a combination of these symptoms, call 911, or seek emergency care and say, "I'm concerned about sepsis!"

Risk Factors:

- Diabetes
- Maternal infection (inflammation or infection in the breast tissues)
- Viral or bacterial infection, such as a URI
- Obesity may also increase your risk of developing sepsis.

Or had:

- A recent surgery
- A miscarriage or stillbirth
- Premature rupture of membranes
- Damaged placental vessels
- An infection in the skin or soft tissues
- Wound infection
- Certain infections during pregnancy
- Those with a compromised immune system
- Diabetes

For more information, please visit sepsis.org

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Patient Education Resources

- Spanish resources: tri-fold, infographic, sepsis information guide
- Coming soon: sepsis and pregnancy education video and PSA in Spanish
Patient Education Videos

Sepsis
Pregnancy and Childbirth

Pregnancy and Childbirth Education Video

Kayleigh’s Maternal Sepsis Story

Maile’s Maternal Sepsis Story

Amanda’s Maternal Sepsis Story
Maternal Sepsis Week

• Annual observance to raise awareness of the unique signs and symptoms of maternal sepsis,
• Bring to life the personal experiences of the women who endured it
• Remember those who have passed
• Resources for the public, providers, policy leaders
• May 9-15, 2021
Provider Education and Training

- Sepsis & Pregnancy Training Module with CNE and CME, in partnership with ACOG District II – coming soon to Sepsis Alliance Institute!
- www.sepsisinstitute.org
ACOG District II SAFE MOTHERHOOD INITIATIVE

The SMI Maternal Sepsis bundle is available at: acogny.org

Don’t forget to download the SMI app for the ACOG District II SMI bundles & related materials!

ACOG District II Safe Motherhood Initiative
Maternal Sepsis Workgroup Co-Leads:

Adiel Fleischer, MD, FACOG – Northwell Health
Lisa M. Nathan, MD, MPH, FACOG – Montefiore Medical Center

ACOG District II Safe Motherhood Initiative Staff:

Kristin DeVries, MA, MPP
518-436-3461
kdevries@ny.acog.org

• FREE!
• Available for Apple & Android devices
• Continually updated to reflect latest guidance
• For providers
Key Elements and resources include:
• A new two-step approach to screening
• Algorithm for Maternal Sepsis Evaluation Flow Chart
• Assessment and monitoring recommendations
• Guidelines for distinguishing chorioamnionitis/intraamniotic infection from sepsis
• Guidance on antibiotics and source control by infectious conditions

https://www.cmqcc.org/resources-toolkits/toolkits/improving-diagnosis-and-treatment-maternal-sepsis
Together We Can Make Our Nation “SEPSIS SAFE”
Thank You!

Sepsis.org

@sepsisalliance
Questions and Discussion
Staying Connected

• All slides, materials, and call recordings will be shared with participants following the call and also posted to the IHI website (www.ihi.org/maternalhealth)

• If you’d like to be added to the IHI maternal health email list or have additional questions about this programming, please contact us at maternalhealth@ihi.org.

• Public webinars are offered every 1-2 months. Information about upcoming calls will be shared ahead of time through IHI and NNPQC listservs.
Next Webinar

• Patient Engagement: Tools to Move Past the Story
• Monday, November 9, 1-2 pm ET
• **Sign up link** will be circulated in the follow-up email from today’s webinar
Thank you for joining us

IHI Better Maternal Outcomes Initiative
National Network of Perinatal Quality Collaboratives